

REMARKS

The Office Action rejects claims 1, 4-6, 12, and 14-16 under 35 U.S.C. 102(b) as being anticipated by Lemelson (US patent 3573045). The Office Action further rejects claims 1, 4-6, 12, and 14-16 under 35 U.S.C. 102(b) as being anticipated by Schiffman (US patent 4102734).

Applicants have amended claim 1 to recite an optical apparatus for exposing light on a surface of a spherical semiconductor device. The optical apparatus has a mask for providing a pattern of light through an exposure contour which undergoes temporal changes to collectively represent an image. The exposure contour is curved in opposition to a curvature of the surface of the spherical semiconductor device. A lens is positioned to focus the pattern of light along a focal line across the surface of the spherical semiconductor device. The exposure contour has a first width in a middle region of the focal line and is made progressively wider than the first width in both directions orthogonal to the focal line toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curvature of the spherical semiconductor device. A motor has a shaft coupled to the spherical semiconductor device for rotating the spherical semiconductor device in relation to the temporal changes in the pattern of light to expose the pattern of light over a portion of the surface of the spherical semiconductor device.

Neither Lemelson nor Schiffman teaches or suggests a mask for providing a pattern of light through an exposure contour which undergoes temporal changes to collectively represent an image. The exposure contour is curved in opposition to a

curvature of the surface of the spherical semiconductor device. Neither of these prior art references shows an exposure contour which is curved in opposition to a curvature of the surface of the spherical semiconductor device.

Moreover, neither Lemelson nor Schiffman discloses a lens positioned to focus the pattern of light along a focal line across the surface of the spherical semiconductor device. The exposure contour has a first width in a middle region of the focal line and is made progressively wider than the first width in both directions orthogonal to the focal line toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curvature of the spherical semiconductor device. Again, neither reference has an exposure contour that is made progressively wider in both directions orthogonal to the focal line. This distinguishing feature is important as the additional width of the exposure contour (e.g. 97 in FIG. 5a) moving away from the line of focus (95 in FIG. 6a) provides a longer exposure time for those areas receiving a lower light intensity. The varying width of the exposure contour is determined by integrating the decrease in light intensity. The closer to the edge of the exposure contour, and the lower the light intensity, the longer the exposure time due to the progressively wider exposure contour. The net effect is a substantially uniform light intensity across the width of the exposure area and greater resolution in the photolithographic process, see paragraphs [0026]-[0028] of the Applicants' specification.

Therefore, claim 1 is believed to patentably distinguish over the Lemelson and Schiffman references. Claims 4-5 and 9-11 are believed to be in condition for allowance as each is

dependent from an allowable base claim. Claim 6 has been cancelled.

As for claim 12, the amended claim recites a method of exposing light on a surface of a spherical semiconductor device comprising the steps of providing a pattern of light through an exposure contour of a mask which undergoes temporal changes to collectively represent an image, directing the pattern of light along a focal line across the surface of the spherical semiconductor device, wherein the exposure contour has a first width in a middle region of the focal line and is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across a curvature of the spherical semiconductor device, and rotating the spherical semiconductor device in relation to the temporal changes in the pattern of light to expose the pattern of light over a portion of the surface of the spherical semiconductor device.

With respect to claim 12, neither Lemelson nor Schiffman discloses an exposure contour having a first width in a middle region of the focal line and made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across a curvature of the spherical semiconductor device. These prior art references have no such feature.

Therefore, claim 12 is believed to patentably distinguish over the Lemelson and Schiffman references. Claims 14-15 and 18-20 are believed to be in condition for allowance as each is dependent from an allowable base claim. Claim 16 has been cancelled.

The Office Action rejects claims 28-32 and 34 under 35 U.S.C. 102(b) as being anticipated by Kanatake (US patent 6130742).

Applicants have amended claim 28 to recite a method of exposing light on a semiconductor device having a curved surface comprising the steps of generating a pattern of light through an exposure contour of a mask, directing the pattern of light along a focal line across the curved surface of the semiconductor device, wherein the exposure contour has a first width in a middle region of the focal line and is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device, and rotating the semiconductor device to expose the pattern of light over a portion of the curved surface of the semiconductor device.

The Kanatake reference does not teach or suggest an exposure contour having a first width in a middle region of the focal line and made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device.

Therefore, claim 28 is believed to patentably distinguish over the Kanatake reference. Claims 29-31 and 34 are believed to be in condition for allowance as each is dependent from an allowable base claim. Claim 32 has been cancelled.

The Office Action rejects claims 12, 14, 16, and 18 under 35 U.S.C. 102(b) as being anticipated by Donadio (US patent 6027863). Claim 12 has been amended as described above.

With respect to claim 12, the Donadio reference does not teach or suggest an exposure contour that is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across a curvature of the spherical semiconductor device.

Therefore, claim 12 is believed to patentably distinguish over the Donadio reference. Claims 14-15 and 18-20 are believed to be in condition for allowance as each is dependent from an allowable base claim. Claim 16 has been cancelled.

The Office Action rejects claims 1-6, 9-16, 19-25, 28-32, and 34 under 35 U.S.C. 102(b) as being anticipated by Mei (US patent 6529262). Claims 1, 12, and 28 have been amended as described above.

As for claim 1, the Mei reference does not teach or suggest a mask providing an exposure contour which is curved in opposition to a curvature of the surface of the spherical semiconductor device. Mei also does not show an exposure contour having a first width in a middle region of the focal line and made progressively wider than the first width in both directions orthogonal to the focal line toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curvature of the spherical semiconductor device.

Therefore, claim 1 is believed to patentably distinguish over the Mei reference. Claims 4-5 and 9-11 are believed to be in condition for allowance as each is dependent from an allowable base claim. Claims 2-3, 6, and 16 have been cancelled.

As for claim 12, the Mei reference does not teach or suggest an exposure contour that is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across a curvature of the spherical semiconductor device.

Therefore, claim 12 is believed to patentably distinguish over the Mei reference. Claims 14-15 and 18-20 are believed to be in condition for allowance as each is dependent from an allowable base claim.

As for claim 21, the amended claim recites a method of manufacturing a semiconductor device having a curved surface comprising the steps of providing a pattern of light through an exposure contour of a mask which undergoes temporal changes to collectively represent an image, directing the pattern of light along a focal line across the curved surface of the semiconductor device, wherein the exposure contour has a first width in a middle region of the focal line and is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device, and rotating the semiconductor device in relation to the temporal changes in the pattern of light to expose the pattern of light over a portion of the curved surface of the semiconductor device.

The Mei reference does not teach or suggest an exposure contour that is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device.

Therefore, claim 21 is believed to patentably distinguish over the Mei reference. Claims 22-24 and 27 are believed to be in condition for allowance as each is dependent from an allowable base claim. Claim 25 has been cancelled.

As for claim 28, the Mei reference does not teach or suggest an exposure contour having a first width in a middle region of the focal line and made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device.

Therefore, claim 28 is believed to patentably distinguish over the Mei reference. Claims 29-31 and 34 are believed to be in condition for allowance as each is dependent from an allowable base claim. Claim 32 has been cancelled.

The Office Action rejects claim 2 under 35 U.S.C. 103(a) as being unpatentable over Schiffman. Claim 2 has been cancelled.

The Office Action rejects claims 1-34 under 35 U.S.C. 103(a) as being unpatentable over Fukano (US patent 6453458) in view of Mei. Claims 1, 12, 21, and 28 have been amended as described above.

As for claim 1, neither the Fukano nor Mei references, taken singularly or in combination, teaches or suggests a mask providing an exposure contour which is curved in opposition to a curvature of the surface of the spherical semiconductor device. In addition, neither the Fukano nor Mei references shows an exposure contour having a first width in a middle region of the focal line and made progressively wider than the first width in both directions orthogonal to the focal line toward each end of the focal line to increase exposure time and achieve a

substantially uniform intensity exposure across the curvature of the spherical semiconductor device.

Therefore, claim 1 is believed to patentably distinguish over the Mei reference. Claims 4-5 and 9-11 are believed to be in condition for allowance as each is dependent from an allowable base claim.

As for claim 12, neither the Fukano nor Mei references, taken singularly or in combination, teaches or suggests an exposure contour that is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across a curvature of the spherical semiconductor device.

Therefore, claim 12 is believed to patentably distinguish over the Mei reference. Claims 14-15 and 18-20 are believed to be in condition for allowance as each is dependent from an allowable base claim.

As for claim 21, neither the Fukano nor Mei references, taken singularly or in combination, teaches or suggests an exposure contour that is made progressively wider than the first width toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device.

Therefore, claim 21 is believed to patentably distinguish over the Mei reference. Claims 22-24 and 27 are believed to be in condition for allowance as each is dependent from an allowable base claim.

As for claim 28, neither the Fukano nor Mei references, taken singularly or in combination, teaches or suggests an exposure contour having a first width in a middle region of the focal line and made progressively wider than the first width

Application Serial No.: 10/538,980
Nishimoto et al.
Response to Office Action mailed March 13, 2006

toward each end of the focal line to increase exposure time and achieve a substantially uniform intensity exposure across the curved surface of the semiconductor device.

Therefore, claim 28 is believed to patentably distinguish over the Mei reference. Claims 29-31 and 34 are believed to be in condition for allowance as each is dependent from an allowable base claim.

Applicant(s) believe that all information and requirements for the application have been provided to the USPTO. If there are matters that can be discussed by telephone to further the prosecution of the Application, Applicant(s) invite the Examiner to call the undersigned attorney at the Examiner's convenience.

The Commissioner is hereby authorized to charge any fees due with this Response to U.S. PTO Account No. 17-0055.

Respectfully submitted,
QUARLES & BRADY STREICH LANG LLP

July 13, 2006

By: 

Robert D. Atkins
Reg. No. 34,288

Address all correspondence to:
Robert D. Atkins
Quarles & Brady Streich Lang LLP
One Renaissance Square
Two North Central Avenue
Phoenix, AZ 85004
Telephone: (602) 229-5311
Facsimile: (602) 229-5690
E-mail: rda@quarles.com